hw5

October 23, 2019

```python
[1]: from gurobipy import *
```

```python
[16]: num_nodes = 8
      num_arcs = 16
      origin = 1
      destination = 8
```

```python
[29]: f = open("shortest_path_data.txt", "r")
      f2=next(f)
      for lines in f:
          print(lines)
```

```
1 2 1.0

1 3 2.0

2 3 1.0

2 4 5.0

2 5 2.0

3 4 2.0

3 5 1.0

3 6 4.0

4 5 3.0

4 6 6.0

4 7 8.0

5 6 3.0

5 7 7.0
```

```
6 7 5.0

6 8 2.0

7 8 6.0
```

[35]:
```
cost_12 = 1.0
cost_13 = 2.0
cost_23 = 1.0
cost_24 = 5.0
cost_25 = 2.0
cost_34 = 2.0
cost_35 = 1.0
cost_36 = 4.0
cost_45 = 3.0
cost_46 = 6.0
cost_47 = 8.0
cost_56 = 3.0
cost_57 = 7.0
cost_67 = 5.0
cost_68 = 2.0
cost_78 = 6.0
```

[37]:
```
myModel = Model ("Shortest_path_data")
x13 = myModel.addVar (vtype = GRB.CONTINUOUS, name = "x13")
x12 = myModel.addVar (vtype = GRB.CONTINUOUS, name = "x12")
x23 = myModel.addVar (vtype = GRB.CONTINUOUS, name = "x23")
x25 = myModel.addVar (vtype = GRB.CONTINUOUS, name = "x25")
x24 = myModel.addVar (vtype = GRB.CONTINUOUS, name = "x24")
x35 = myModel.addVar (vtype = GRB.CONTINUOUS, name = "x35")
x34 = myModel.addVar (vtype = GRB.CONTINUOUS, name = "x34")
x36 = myModel.addVar (vtype = GRB.CONTINUOUS, name = "x36")
x45 = myModel.addVar (vtype = GRB.CONTINUOUS, name = "x45")
x46 = myModel.addVar (vtype = GRB.CONTINUOUS, name = "x46")
x47 = myModel.addVar (vtype = GRB.CONTINUOUS, name = "x47")
x56 = myModel.addVar (vtype = GRB.CONTINUOUS, name = "x56")
x57 = myModel.addVar (vtype = GRB.CONTINUOUS, name = "x57")
x67 = myModel.addVar (vtype = GRB.CONTINUOUS, name = "x67")
x68 = myModel.addVar (vtype = GRB.CONTINUOUS, name = "x68")
x78 = myModel.addVar (vtype = GRB.CONTINUOUS, name = "x78")
myModel.update()
```

[38]:
```
objExpr = LinExpr()
objExpr += cost_13*x13
objExpr += cost_12*x12
objExpr += cost_23*x23
objExpr += cost_25*x25
objExpr += cost_24*x24
```

```
objExpr += cost_35*x35
objExpr += cost_34*x34
objExpr += cost_36*x36
objExpr += cost_45*x45
objExpr += cost_46*x46
objExpr += cost_47*x47
objExpr += cost_56*x56
objExpr += cost_57*x57
objExpr += cost_67*x67
objExpr += cost_68*x68
objExpr += cost_78*x78
myModel.setObjective(objExpr, GRB.MINIMIZE)
```

[39]:
```
firstConst = LinExpr()
firstConst += x13
firstConst += x12
myModel.addConstr( lhs = firstConst, sense = GRB.EQUAL, rhs = 1, name =␣
 ↪"firstconstraint" )

secondConst = LinExpr()
secondConst += x23
secondConst += x25
secondConst += x24
secondConst -= x12
myModel.addConstr( lhs = secondConst, sense = GRB.EQUAL, rhs = 0, name =␣
 ↪"secondconstraint")

thirdConst = LinExpr()
thirdConst += x34
thirdConst += x35
thirdConst += x36
thirdConst -= x13
thirdConst -= x23
myModel.addConstr( lhs = thirdConst, sense = GRB.EQUAL, rhs = 0, name =␣
 ↪"thirdconstraint")

fourthConst = LinExpr()
fourthConst += x45
fourthConst += x46
fourthConst += x47
fourthConst -= x34
fourthConst -= x24
myModel.addConstr( lhs = fourthConst, sense = GRB.EQUAL, rhs = 0, name =␣
 ↪"fourthconstraint")

fifthConst = LinExpr()
fifthConst += x56
```

```
fifthConst += x57
fifthConst -= x25
fifthConst -= x35
fifthConst -= x45
myModel.addConstr( lhs = fifthConst, sense = GRB.EQUAL, rhs = 0, name =␣
 ↪"fifthconstraint")

sixthConst = LinExpr()
sixthConst += x68
sixthConst += x67
sixthConst -= x36
sixthConst -= x56
sixthConst -= x46
myModel.addConstr( lhs = sixthConst, sense = GRB.EQUAL, rhs = 0, name =␣
 ↪"sixthconstraint")

seventhConst = LinExpr()
seventhConst += x78
seventhConst -= x67
seventhConst -= x57
seventhConst -= x47
myModel.addConstr( lhs = seventhConst, sense = GRB.EQUAL, rhs = 0, name =␣
 ↪"seventhconstraint")

eighthConst = LinExpr()
eighthConst += x78
eighthConst += x68
myModel.addConstr( lhs = eighthConst, sense = GRB.EQUAL, rhs = 1, name =␣
 ↪"eighthconstraint")

myModel.update()
myModel.write ( filename = "Shortest_path_data.lp")
```

[40]:
```
myModel.optimize()
```

```
Optimize a model with 8 rows, 16 columns and 32 nonzeros
Coefficient statistics:
  Matrix range     [1e+00, 1e+00]
  Objective range  [1e+00, 8e+00]
  Bounds range     [0e+00, 0e+00]
  RHS range        [1e+00, 1e+00]
Presolve removed 2 rows and 4 columns
Presolve time: 0.03s
Presolved: 6 rows, 12 columns, 24 nonzeros

Iteration    Objective       Primal Inf.    Dual Inf.      Time
       0    3.9920000e+00   1.503000e+00   0.000000e+00      0s
       3    8.0000000e+00   0.000000e+00   0.000000e+00      0s
```

```
Solved in 3 iterations and 0.05 seconds
Optimal objective   8.000000000e+00
```

[41]:
```python
print("optimal Objective: \n" + str(myModel.ObjVal))
print("optimal Solution:")
allVars = myModel.getVars()
for curVar in allVars:
    print(curVar.varName + " " + str(curVar.x))
```

```
optimal Objective:
8.0
optimal Solution:
x13 0.0
x12 1.0
x23 1.0
x25 0.0
x24 0.0
x35 1.0
x34 0.0
x36 0.0
x45 0.0
x46 0.0
x47 0.0
x56 1.0
x57 0.0
x67 0.0
x68 1.0
x78 0.0
```

[ ]:

```
Gurobi 8.1.1 (mac64, Python) logging started Wed Oct 23 18:15:14 2019

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Optimize a model with 8 rows, 0 columns and 0 nonzeros
Coefficient statistics:
  Matrix range     [0e+00, 0e+00]
  Objective range  [0e+00, 0e+00]
  Bounds range     [0e+00, 0e+00]
  RHS range        [1e+00, 1e+00]
Presolve time: 0.02s

Solved in 0 iterations and 0.02 seconds
Infeasible model
Optimize a model with 8 rows, 16 columns and 32 nonzeros
Coefficient statistics:
  Matrix range     [1e+00, 1e+00]
  Objective range  [1e+00, 8e+00]
  Bounds range     [0e+00, 0e+00]
  RHS range        [1e+00, 1e+00]
Presolve removed 2 rows and 4 columns
Presolve time: 0.03s
Presolved: 6 rows, 12 columns, 24 nonzeros

Iteration   Objective      Primal Inf.    Dual Inf.      Time
    0    3.9920000e+00   1.503000e+00   0.000000e+00      0s
    3    8.0000000e+00   0.000000e+00   0.000000e+00      0s

Solved in 3 iterations and 0.05 seconds
Optimal objective  8.000000000e+00
```

\ Model Shortest_path_data
\ LP format – for model browsing. Use MPS format to capture full model detail.
Minimize
  2 x13 + x12 + x23 + 2 x25 + 5 x24 + x35 + 2 x34 + 4 x36 + 3 x45 + 6 x46
    + 8 x47 + 3 x56 + 7 x57 + 5 x67 + 2 x68 + 6 x78
Subject To
 firstconstraint: x13 + x12 = 1
 secondconstraint: – x12 + x23 + x25 + x24 = 0
 thirdconstraint: – x13 – x23 + x35 + x34 + x36 = 0
 fourthconstraint: – x24 – x34 + x45 + x46 + x47 = 0
 fifthconstraint: – x25 – x35 – x45 + x56 + x57 = 0
 sixthconstraint: – x36 – x46 – x56 + x67 + x68 = 0
 seventhconstraint: – x47 – x57 – x67 + x78 = 0
 eighthconstraint: x68 + x78 = 1
Bounds
End